Densities and relative abundance of forage fishes within floodplain wetlands

Expectation:	A significant increase in mean annual density of forage fishes within restored broadleaf marsh habitats. Mean annual relative abundance of forage fish species will comprise approximately 60% of total numbers of floodplain fish.
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Relevant Endpoint(s):	Restoration - Biological Integrity - Community Structure Restoration - Biological Integrity - Food Web Structure Restoration - System Functional Integrity - Habitat Quality Restoration - System Functional Integrity - Habitat Use Restoration - System Functional Integrity - River/Floodplain Interactions

Baseline Condition:

Channelization of the Kissimmee River led to drainage of approximately 12,000 hectares of floodplain wetlands. Channelized floodplain habitats typically lack connectivity to the river channel (except during flood conditions), are shallow and ephemeral, and lack substantial water level fluctuations. As a result, these habitats are inhospitable for large-bodied fishes, but support populations of small-bodied forage fishes.

Three floodplain habitats (broadleaf marsh, woody shrub, pasture) within pools A, C, and D were sampled monthly between August 1997 and January 1999 using a m^3 throw trap. Forage fish comprised 99.9% of the 3159 fishes collected. Mean annual density of forage fish over the two-year period was ≤ 5.5 fish/m^2 in all habitats. The community was dominated by Poeciliidae; *Gambusia holbrooki* and *Heterandria formosa* comprised approximately 60.7% of all fish sampled.

Milleson (1976) found that Poeciliids accounted for 79% of the floodplain fish community of a re-flooded marsh (impounded) in pool B, while Toth (1991) found Poeciliids comprised 97% of floodplain fishes within a hydrologically enhanced broadleaf marsh in pool B.

Reference Conditions:

Historical data on floodplain fish community structure of the Kissimmee River ecosystem are limited to a single sampling event (FGFWFC 1957). Consequently, reference conditions were derived from a comparable marsh ecosystem of peninsular Florida and relevant data from the FGFWFC (1957) report. In the FGFWFC study, 24 species (Table 1) were collected in a 0.20 acre sample of marsh habitat. Thirteen of the 24 species collected were forage fishes, which made up 62.5% of all fishes sampled. Eighty-six percent of the 576 forage fishes sampled were Cyprinodontids and Poeciliids. A conceptual model of the pre-channelized river (Trexler 1995) suggests the floodplain fish community was characteristically composed of forage fishes and larvae and juveniles of large predatory species.

The Florida Everglades serves as a reference site for floodplain fish assemblages of the historic Kissimmee River due to similarities in geology, ecoregion, climate and annual rainfall, wetland marsh

hydroperiod and vegetation composition, and zoogeography of freshwater fish fauna.

Jordan et al. (1997) found 29 species of fishes utilizing wet prairie habitats within Water Conservation Area 3 of the Florida Everglades, 17 of which occurred within the historic Kissimmee River floodplain. These wet prairies supported an average density of 26 fishes per m^2. Poeciliids (*Gambusia affinis, Heterandria formosa*) and Cyprinodontids (*Lucania goodei*) were the most abundant forage fishes and accounted for 86% of the total numbers collected. Jordan et al. (in press) found forage fish composition within backwater ponds of the Florida Everglades declined to 40-60% during recession periods due to an influx of large-bodied piscivorous fishes seeking deep water refuge (Loftus and Eklund 1994), and an associated increase in predation (Kushlan 1976, 1980, Loftus and Eklund 1994).

Mechanism relating restoration:

Re-establishment of historic hydrologic characteristics will restore floodplain habitats, including broadleaf marsh within areas that currently exist as pasture and woody shrub (Toth et al. 1995). Restoration of floodplain fish populations will occur through re-colonization by fish species that occur within inundated floodplain habitats and/or adjacent river channels. Species composition, abundance, and densities of forage fish will fluctuate due to water depth, hydroperiod, stem density of emergent vegetation, prey availability, composition of predator assemblages, and areal coverage of floodplain inundation (Welcomme 1979, Kushlan 1980, Lowe 1986, Heck and Crowder 1991, Connolly 1994, Loftus and Ekland 1994, Jordan et al. 1996, 1998).

Forage fish populations are expected to increase during periods when water depths are shallow (< 50 cm) and hydroperiods are short (≤3 months; F. Jordan pers. com.) due to their reproductive mode (live bearer) and reproductive frequency (Lee et al. 1980, Loftus and Ekland 1994). During periods of limited inundation, fishes will concentrate in depressions within the marsh landscape. Survivors from these events will re-colonize floodplain habitats during more favorable hydrologic conditions. The percentage of forage fishes will decrease during periods of high water primarily through an increase in abundance of large-bodied species (Loftus and Eklund 1994) and secondarily through predation by piscivorous species (Kushlan 1976, 1980, Loftus and Ekland 1994) and competition for available resources (Chick and McIvor 1997). Due to dense vegetative cover, large-bodied fish movement onto established marshes will require water depths between 0.5-1.0 meters.

Adjustment for External Constraints:

Fish will be absent from floodplain marshes when the entire floodplain dries during extreme drought.

Time course:

Forage fish will begin migrating onto floodplain habitats immediately following inundation. Populations are expected to increase until water depths allow for immigration of large-bodied, piscivorous species onto the floodplain. Establishment of forage fish populations resembling those of the pre-channelized system is expected to occur within 3-5 years. Restoration time frames may require adjustment if appropriate hydrologic characteristics are not met or are delayed.

Means of Evaluation:	Throw trap sampling will begin immediately following inundation of broadleaf marsh habitats. Post restoration sampling of woody shrub and pasture habitats will occur when broadleaf marsh re-establishes, which is expected 3 to 5 years following inundation. Methods will be identical to those utilized for baseline studies. Sampling will be conducted monthly, for two year intervals, beginning on the 1st, 5th, and 9th year following floodplain inundation. Mean annual density and relative abundance of forage fishes will be based on each two-year block of post restoration evaluation data.

Table 1: Fish species collected by GFC (1957) in pre-channelized marsh habitat.

GAME FISH:		
	Centrarchidae	
		Micropterus salmoides largemouth bass
		Lepomis auritrus redbreast sunfish
		Lepomis machrochirus bluegill
		Lepomis gulosus warmouth
		Lepomis microlophus redear sunfish
		Lepomis punctatus spotted sunfish
		Pomoxis nigromaculatus black crappie
	Esocidae	
		Esox americanus redfin pickerel
CATFISH:		
	Ictaluridae	
		Ameiurus catus white catfish
		Ictalurus punctatus channel catfish
FORAGE FISH:		
	Aphredoderidae	
		Aphredoderus sayanus pirate perch
	Atherinidae	
		Labidesthes sp. silverside
	Centrarchidae	
		Elassoma evergladei Everglades pygmy sunfish
		Ennecanthus gloriosus blue-spotted sunfish
	Cyprinodontidae	
		Fundulus chrysotus golden topminnow
		Lacania goodei bluefin killifish
		Notemigonous crysoleucas golden shinner
		Notropis maculatus tailight shinner
		Notropis petersoni coastal shinner
	Ictaluridae	
		Noturus gyrinus tadpole madtom
	Percidae	
		Etheostoma fusiforme swamp darter
	Poeciliidae	
		Gambusia holbrooki eastern mosquitofish
		Heterandria formosa least killifish
ROUGH FISH:		
	Catostomidae	
		Erimyzon sucetta lake chubsucker

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